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## Space Weather Technical Forecast

Issued on Wednesday, 27 April 2022 at 13:26 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>**

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**Space Weather Forecast Headline: Chance of M-class flares (R1/R2 Radio Blackouts), with a very slight chance of X-class flares (R3 Radio Blackouts).**

### Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** Solar activity has been Low, with a number of low-mid C-class flares observed. There are currently nine sunspot regions on the visible disc. AR2994 (Eko/Beta-Gamma) in the far northwestern quadrant remains the active of these. The remaining sunspot groups are all rather simple and small magnetic regions, or benign alpha spots. A C3 flare from AR2996 at 27/0907 UTC appears responsible for a CME resulting from a filament eruption. Initial LASCO and STEREO-A imagery suggest this CME is directed to the north of earth, however, further imagery and modelling is required to confirm this. Otherwise no Earth-directed CMEs have been observed in available imagery.

**Solar Wind / Geomagnetic Activity:** The solar wind, as observed at L1, has slowly and erratically increased from around 400km/s to 430km/s (slightly elevated) during the period. Density was at Below Average levels until around 27/0400 UTC when Average density levels were observed. Overall magnetic field strength was mainly weak, but with an increase to Moderate levels from around 27/0600 UTC. The north-south component, Bz, has generally varied weakly, though has been Moderate and mainly positive since 27/0600 UTC, though a deviation to -10nT Bz was observed just before 27/1200 UTC. The phi angle has been predominantly positive (away from the sun). Geomagnetic activity has been Quiet (Kp 1-2) throughout.

**Energetic Particles / Solar Radiation:** The high energy proton flux (10 MeV) was at background levels throughout. The high energy electron flux (greater than 2MeV) has been at background to moderate levels throughout, following an expected diurnal trend. The associated 24 hour fluence was below the Active (1e8 integrated pfu) level on a generally steady trend, with 1.43e7 integrated pfu recorded at 27/0000 UTC.

### Four-Day Space Weather Forecast Summary

**Solar Activity:** Solar activity is expected to be Low, with a chance of Moderate activity and a very slight chance of High activity.

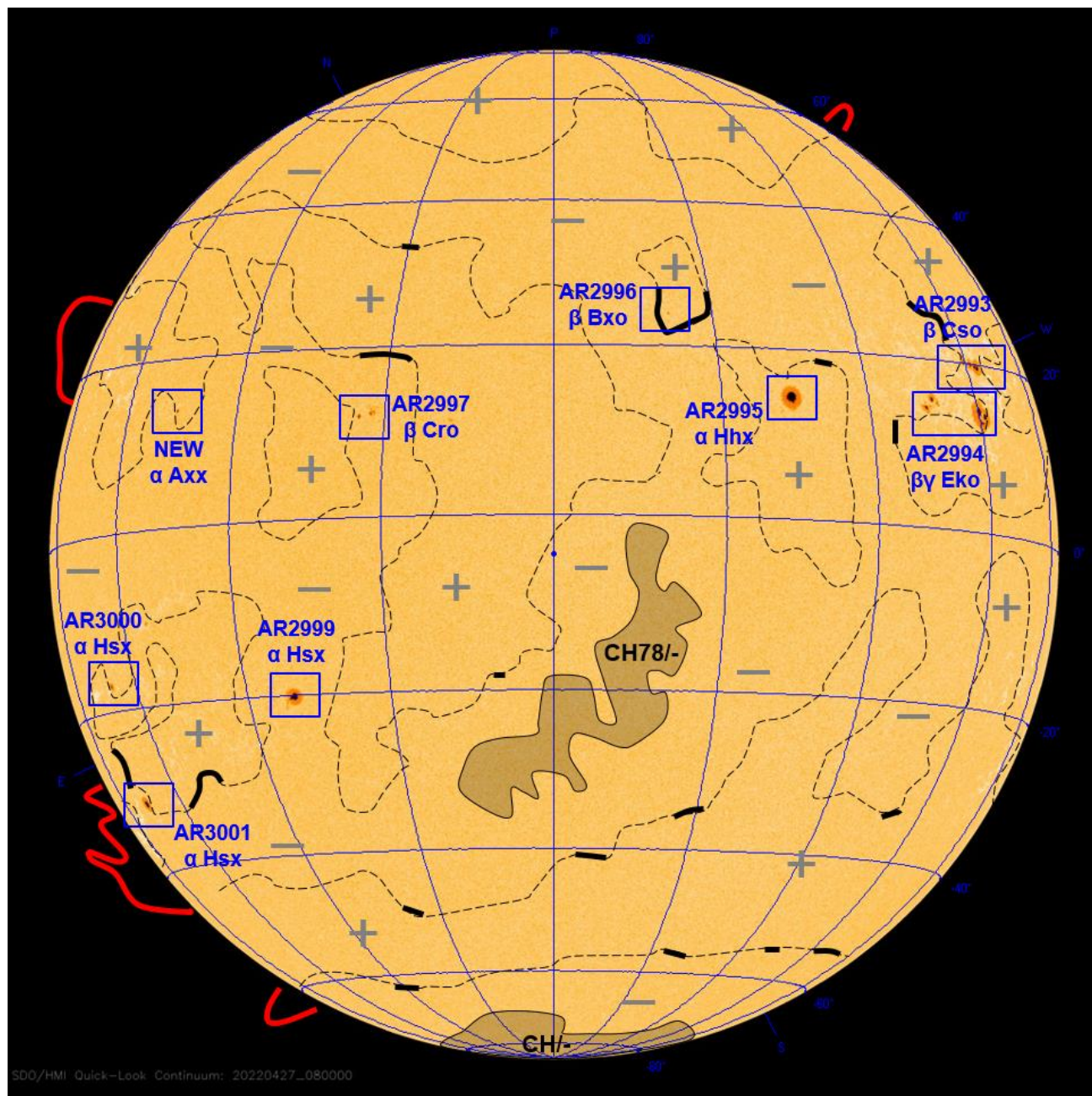
**Solar Wind / Geomagnetic Activity:** No Earth directed CMEs are currently forecast during the period, however, a filament eruption and associated CME from AR2996 associated with a flare at 27/0907 UTC requires further imagery and modelling to confirm a miss at Earth. Solar winds are expected to be slightly elevated speeds through 27 April and much of 28 April. Speeds are then forecast to increase to 500-550km/s either late on 28 April or on 29 April due to the onset of the high speed stream from Coronal Hole 78. Geomagnetic activity is forecast to be mainly Quiet, with a chance of Unsettled or an Active interval on 27 and 28 April, but could reach Active to G1/Minor storms on 28 April and into 29 April due to the expected onset of the high speed stream. Unsettled intervals, with a risk of Active are then likely on 29 and 30 April.

**Energetic Particles / Solar Radiation:** The high energy proton flux (greater than 10 MeV) is at background levels, and is most likely to remain so through the next four days, although a

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significant sunspot region is now transiting the far northwest quadrant and brings a slight chance of solar radiation storms reaching Earth. The high energy electron flux (greater than 2MeV) is expected to be at mainly background to moderate levels, but with a trend towards the high ( $1e3$  pfu) threshold possible on 30 April. Electron fluence is expected to remain below the Active ( $1e8$  integrated pfu) threshold but with a rising trend late in the period.

**Figure 1. Solar Analysis Valid 27/0800 UTC.**



**Key:** Filament \_\_\_\_, Prominence \_\_\_\_, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson  $\alpha$ - $\beta$ - $\beta\gamma$ - $\beta\gamma\delta$  and Zurich-McIntosh Axx etc.

**Geomagnetic Storms:**

There are no Earth-directed CMEs forecast for the next four days.

Solar winds are expected to be slightly elevated speeds through 27 April and much of 28 April. Speeds are then forecast to increase to 500-550km/s (elevated) either late on 28 April or on 29 April due to the onset of the high speed stream from Coronal Hole 78. This is supported by observations from STEREO A, which likely encountered a CIR (co-rotating interaction region) early on 26 April. As STEREO A is 2.5 days ahead of Earth, this would suggest an arrival late on 28 April. A high speed stream of 500-550km/s is then forecast, based on persistence, as this is a recurrent feature. A slight uncertainty is that the anticipated geoeffective longitude of Coronal Hole 78 would support an arrival time of early April 29 at Earth, so is accounted for in Geomagnetic activity probabilities.

Geomagnetic activity is forecast to be mainly Quiet on 27 and 28 April, but could reach Active to G1/Minor storms on 28 April and into 29 April due to the expected onset of the high speed stream from Coronal Hole 78. Unsettled intervals, with a risk of Active are then likely on 29 and 30 April.

| Geo-Magnetic Storm          | Level    | Past 24 Hours<br>(Yes/No) | Day 1<br>(00-24 UTC) | Day 2<br>(00-24 UTC) | Day 3<br>(00-24 UTC) | Day 4<br>(00-24 UTC) |
|-----------------------------|----------|---------------------------|----------------------|----------------------|----------------------|----------------------|
| Probability<br>(Exceedance) |          |                           | (%)                  | (%)                  | (%)                  | (%)                  |
| Minor or Moderate           | G1 to G2 | No                        | 1                    | 20                   | 20                   | 5                    |
| Strong                      | G3       | No                        | 1                    | 1                    | 1                    | 1                    |
| Severe                      | G4       | No                        | 1                    | 1                    | 1                    | 1                    |
| Extreme                     | G5       | No                        | 1                    | 1                    | 1                    | 1                    |

**Geomagnetic Activity - Earthbound Coronal Mass Ejections – None expected.**

**Radio Blackouts - X-Ray Flares:**

Solar activity is expected to be Low to Moderate over the next four days, with a very slight chance of High activity.

AR2994 (Eko/Beta-Gamma) in far northwest quadrant is the largest and most complex sunspot group on the visible disc. This region presents the bulk of the flare risk for the next two or three days before it rotates over the northwest limb and the earth-facing disc. The remaining eight sunspot groups are all rather simple and small magnetic regions, or benign alpha spots.

There appears to be the emergence of a sunspot group in the southeast, however, for now it is not included in sunspot analysis. A new region is rotating over the northeast limb, however, it is too foreshortened in available imagery to make an accurate assessment at present.

A number of filaments are being monitored for potential eruptions, especially in the western hemisphere which could result in an Earth-directed CME.

| X Ray Flares | Level               | Past 24 Hours<br>(Yes/No) | Day 1<br>(00-24 UTC) | Day 2<br>(00-24 UTC) | Day 3<br>(00-24 UTC) | Day 4<br>(00-24 UTC) |
|--------------|---------------------|---------------------------|----------------------|----------------------|----------------------|----------------------|
| Probability  |                     |                           | (%)                  | (%)                  | (%)                  | (%)                  |
| Active       | R1-R2<br>M Class    | No                        | 40                   | 40                   | 20                   | 20                   |
| Very Active  | R3 to R5<br>X Class | No                        | 5                    | 5                    | 3                    | 3                    |

**Solar Radiation Storms - (High Energy Protons):**

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background levels, and is most likely to remain so through the next four days. However, AR2994 in particular brings the possibility of isolated high M-class to low X-class flares. There is a slight chance that solar radiation storms from any such events may be observed at Earth as they rotate across the northwestern quadrant.

| Radiation Storms            | Level<br>( $\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$ ) | Past 24 Hours<br>(Yes/No) | Day 1<br>(00-24 UTC) | Day 2<br>(00-24 UTC) | Day 3<br>(00-24 UTC) | Day 4<br>(00-24 UTC) |
|-----------------------------|------------------------------------------------------------|---------------------------|----------------------|----------------------|----------------------|----------------------|
| Probability<br>(Exceedance) |                                                            |                           | (%)                  | (%)                  | (%)                  | (%)                  |
| Active                      | $\geq \text{S1}$                                           | No                        | 10                   | 10                   | 5                    | 5                    |
| Very Active                 | $\geq \text{S3}$<br>*                                      | No                        | 1                    | 1                    | 1                    | 1                    |

\*  $\text{S3} \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$  and / or  $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$ . ( $\text{pfu} = \text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$ )

## High Energy Electrons Event ( $\geq 2\text{MeV}$ ):

The high energy electron flux (greater than 2MeV) is expected to vary between background and moderate levels on 27 and 28 April in a benign solar wind environment. The CIR ahead of the next high speed stream (Coronal Hole 78) is then likely to compress the radiation belts and redistribute electrons, leading to a drop in the flux. A recovery in counts is then expected through 30 April, with the electron flux increasingly likely to reach the high level ( $1\text{e}3$  pfu) at the diurnal maxima.

Electron fluence values are likely to remain below the Active threshold ( $1\text{e}8$  integrated pfu) through the period, but with a rising trend, most likely on 30 April.

| GEO Electron Environment | Level ( $\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$ ) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|--------------------------|-----------------------------------------------------------|------------------------|-------------------|-------------------|-------------------|-------------------|
| Probability (Exceedance) |                                                           |                        | (%)               | (%)               | (%)               | (%)               |
| Active                   | $\geq 2 \text{ MeV}$<br>$\geq 1 \times 10^8$              | No                     | 1                 | 1                 | 5                 | 20                |
| Very Active              | $\geq 2 \text{ MeV}$<br>$\geq 1 \times 10^9$              | No                     | 1                 | 1                 | 1                 | 1                 |

Figure 2: Latest MOSWOC REFM output.

